REMARKS

Reconsideration and allowance of the present patent application based on the following remarks are respectfully requested.

Claims 1, 7-14, 16, 17, 20 and 23-25 remain pending in the present application.

Claim 1 has been amended.

Claim Rejections – 35 USC § 103

Claims 1, 7-13, 16 and 24 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,333,016 to Resasco et al. (hereinafter "Resasco '016") in view of Weidenkaff et al., Mat. Sci. Engr. C19, pp.119-123, 2002 (hereinafter "Weidenkaff") and U.S. Patent Application Publication No. 2003/0086859 to Kawakami et al. (hereinafter "Kawakami"). Applicant respectfully traverses this rejection for at least the following reasons.

Resasco '016 discloses a method of producing carbon nanotubes involving the step of forming a bimetallic catalyst *in situ* through decomposition of a precursor compound such as bis(cyclopentadienyl) cobalt or bis(cyclopentadienyl) molybdenum chloride (see, column 5, lines 26 to 29 in Resasco '016). As the Examiner acknowledges, Resasco '016 does not disclose, teach or suggest that the metal salt can be a formate or oxalate. Resasco '016 does not disclose, teach or suggest a nickel, iron or cobalt formate or oxalate. In addition, as acknowledged in the Office Action, Resasco '016 does not teach that the particles are fluidized.

Furthermore, as acknowledged by the Examiner, Resasco '016 does not disclose the catalyst precursor materials are decomposed in a non-reducing environment. Indeed, the methods disclosed in Resasco '016 involve pre-treatment of the metallic catalysts with hydrogen gas before reacting the catalyst with a carbon source (see, for instance, Examples 1 to 6 in cols. 8-11 in Resasco '016). Because Resasco '016 requires pre-treating with hydrogen (the hydrogen being a reductant), Resasco '016 clearly teaches the opposite of yielding a transition metal catalyst on the substrate particles by heating without reduction. Resasco '016 uses hydrogen which is known to be a reducing agent to pre-treat the bimetallic catalyst. Therefore, the methods in

Resasco '016 involve pre-treatment of the bimetallic catalysts in a reducing environment containing hydrogen. Whereas, claim 1 requires "providing on the substrate particles a transition metal compound that is a nickel, iron or cobalt formate which is decomposable to yield a transition metal catalyst under a non-reducing atmosphere permitting carbon nanotube formation." (emphasis added).

Weidenkaff fails to cure the deficiencies noted above in Resasco '016. Weidenkaff is directed towards a method of producing multi-walled carbon nanotubes (MWNT) (see, for example, the abstract in Weidenkaff). Indeed, the abstract in Weidenkaff states that "[t]he resulting multiwalled carbon nanotubes are several micrometers long with tube diameters ranging from 5 to 20 nm." Whereas, claim 1 recites, *inter alia*, "the carbon nanotubes are single walled carbon nanotubes."

In response to the arguments filed on May 13, 2010, the Examiner contends that Weidenkaff teaches that when forming a cobalt catalyst from cobalt oxalate, decomposition occurs in air (i.e., a non-reducing environment) and further asserts that the fact that weidenkaff teaches a different precursor and means of decomposing the precursor will not have any bearing on the method of forming the single-walled nanotube (SWNT) because Resasco '016 also teaches that cobalt and nickel catalysts are used to form SWNTs. Applicant respectfully disagrees.

While Applicant acknowledges that Weidenkaff discloses the use of an inert support material (see, page120, first column, section (c) in Weidenkaff) which is coated with an Fe, Co or Ni oxalate and where the decomposition is carried out in air, Applicant, however, respectfully submits that the assertion in part 8 of the office action that Weidenkaff teaches the formation of single-walled nanotubes is incorrect.

In page 120, first column, section (c), Weidenkaff simply refers to multiwalled carbon nanotubes (see, the abstract and the titles to the various figures in Weidenkaff). Furthermore, Table 1 in Weidenkaff also shows that the minimum diameter of the nanotubes formed in Weidenkaff is 5 nm which is typical of multi-walled nanotubes. By way of comparison, single walled nanotubes have a diameter of about 1 nm (see, for example, page 4, line 16 in the specification of the present application). Weidenkaff does not disclose, teach or suggest anywhere the formation of single walled nanotubes.

Claim 1 requires that "the carbon nanotubes are single walled carbon nanotubes."

One of ordinary skill in the art skilled would appreciate that the production of multi walled carbon nanotubes (MWNTs) requires different catalysts and methods of production compared with the production of single walled carbon nanotubes. Therefore, one of ordinary skill in the art would not be motivated to use the teaching of Weidenkaff for the production of single-walled carbon nanotubes.

One of ordinary skill in the art when seeking to prepare single walled carbon nanotubes (SNMTs) would not look to prior art such as Weidenkaff dealing solely with multi-walled nanotubes. The production of single walled nanotubes is not a trivial problem as discussed at page 4, lines 10-13 in the specification of the present application. Therefore, a prior art reference teaching the production of multi-walled nanotubes is not directly applicable to the formation of single walled nanotubes.

As discussed above Weidenkaff discloses a method for the production of multi-walled carbon nanotubes. In contrast, Resasco '016 is directed towards a method for the production of single-walled carbon nanotubes (see, for example, column 3 in Resasco '016).

There is no suggestion, motivation or reason to combine the teachings of Weidenkaff with the teachings of Resasco '016 as Resasco '016 and Weidenkaff are directed to different technical endeavors which use different methods and techniques. Indeed, Resasco '016 endeavors to produce single-walled carbon nanotubes whereas Weidenkaff endeavors to produce multi-walled carbon nanotubes.

In the Advisory Action dated November 8, 2010, the Examiner agrees that Weidenkaff is directed to the formation of MWNT. The Examiner, however, asserts that Resasco '016 explains that either cobalt or nickel precursor can be used to form SWNT and that the carbon-containing gas is what determines whether SWNT or MWNT are formed. The Examiner, therefore, appears to suggest that one of ordinary skill in the art would be motivated to use the oxalate precursors of Weidenkaff in the method of Resasco with a SWNT forming carbon-containing gas. Applicant respectfully disagrees.

Resasco '016 teaches that carbon monoxide (CO) and methane are preferred feed gases for SWNT formation, while use of acetylene promotes MWNT formation

(Resasco '016, column 5, lines 58-60). On the other hand, while Weidenkaff teaches that MWNT are formed in all instances with its catalysts, regardless of the feed hydrocarbon used, these hydrocarbons include both methane and acetylene feed gasses (see, page 120, column 1, lines 2 to 3 in Weidenkaff). Therefore, Weidenkaff teaches that the catalysts are used to control MWNT formation. Whereas, in Resasco '016, SWNT or MWNT formation depends on the feed hydrocarbon. Hence, one of ordinary skill in the art would not combine the teaching of Resasco '016 with the teaching of Weidenkaff when looking to form SWNT.

Furthermore, even if one were to combine Resasco '016 with Weidenkaff, which Applicant does not concede, the combination would still fail to provide the subject matter of claim 1. Indeed, neither Resasco '016 nor Weidenkaff teaches the use of nickel, iron or cobalt formate catalyst precursors.

Furthermore, as recited in claim 1, the transition metal compound that is nickel, iron or cobalt formate is decomposable to form SWNT. For example, by using a decomposable transition metal compound, the transition metal compound does not form an oxide that requires an extra method step of reduction before forming active catalyst. As a result, high purity SWNT with carbon feed gas can be formed, as disclosed in examples 1 and 2 of the present application. Neither Resasco '016 nor Weidenkaff, alone or in combination, discloses a decomposable transition metal compound.

Kawakami fails to cure the deficiencies noted above in the purported combination of Resasco '016 and Weidenkaff. Kawakami was relied upon as allegedly disclosing elution. Kawakami does not disclose, teach or even suggest the subject matter recited in claim 1.

Furthermore, there is no suggestion, motivation or objective reason to utilize Kawakami in the collection of nanoparticles since Kawakami discloses a reaction process that is completely different from the method as claimed in claim 1.

Consequently none of Resasco '016, Weidenkaff and Kawakami, taken alone or in combination, disclose, teach or suggest the subject matter recited in claim 1.

Therefore, Applicant respectfully submits that claim 1 is patentable over the purported combination of Resasco '016, Weidenkaff and Kawakami.

Claims 7-13, 16 and 24 depend from claim 1. Therefore, claims 7-13, 16 and 24 are patentable by virtue of their dependency on patentable claim 1 and for the additional limitations recited therein. Thus, it is respectfully requested that the rejection of claims 1, 7-13, 16 and 24 under 35 U.S.C. § 103(a) over the purported combination of Resasco '016, Weidenkaff and Kawakami be withdrawn.

Claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Weidenkaff and Kawakami in light of U.S. Patent No. 5,500,200 to Mandeville et al. (hereinafter "Mandeville"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 14 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 14 is patentable over the purported combination of Resasco '016, Weidenkaff and Kawakami.

Mandeville fails to overcome the deficiencies noted above in the combination of Resasco '016, Weidenkaff and Kawakami. Mandeville was relied upon as allegedly disclosing a method of forming carbon fibrils using fumed alumina as a carrier particle for the metal catalyst. Mandeville does not disclose, teach or suggest the subject matter recited in claim 1. Consequently none of Resasco '016, Weidenkaff, Kawakami and Mandeville, alone or in combination, disclose, teach or suggest the subject matter recited in claim 14.

Therefore, Applicant respectfully submits that claim 14 is patentable over the purported combination of Resasco '016, Weidenkaff, Kawakami and Mandeville. Thus, it is respectfully requested that the rejection of claim 14 under 35 U.S.C. § 103(a) over the purported combination Resasco '016, Weidenkaff, Kawakami and Mandeville be withdrawn.

Claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Weidenkaff and Kawakami in light of U.S. Patent No. 5,165,909 to Tennent et al. et al. (hereinafter "Tennent '909"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 17 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 17 is patentable over the combination of Resasco '016, Weidenkaff and Kawakami.

Tennent '909 fails to overcome the deficiencies noted above in the combination of Resasco '016, Weidenkaff and Kawakami. Tennent '909 was relied upon as allegedly disclosing a method of forming carbon nanotubes wherein iron oxalate is used as the metal salt for forming the caltalyst. Tennent does not disclose, teach or suggest the subject matter recited in claim 1. Tennent '909 does not disclose, teach or suggest, *inter alia*, "before, during or after contacting the gaseous carbon source with the substrate particles, decomposing the transition metal formate to yield the transition metal catalyst on the substrate particles by heating without reduction; forming single walled carbon nanotubes by decomposition of the carbon source catalysed by the transition metal catalyst," as recited in claim 1. Consequently none of Resasco '016, Weidenkaff, Kawakami and Tennent '909, alone or in combination, disclose, teach or suggest the subject matter recited in claim 17.

Therefore, Applicant respectfully submits that claim 17 is patentable over the purported combination of Resasco '016, Weidenkaff, Kawakami and Tennent '909. Thus, it is respectfully requested that the rejection of claim 17 under 35 U.S.C. § 103(a) over the purported combination Resasco '016, Weidenkaff, Kawakami and Tennent '909 be withdrawn.

Claim 20 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Weidenkaff and Kawakami in light of U.S. Patent No. 6,955,800 to Resasco et al. (hereinafter "Resasco '800"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 20 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 20 is patentable over the combination of Resasco '016, Weidenkaff and Kawakami.

Resasco '800 fails to overcome the deficiencies noted above in the combination of Resasco '016, Weidenkaff and Kawakami. Resasco '800 teaches a method for catalytic production of carbon nanotubes. Resasco '800 does not disclose, teach or

suggest the subject matter recited in claim 1. In addition, Resasco '800 does not disclose the catalyst precursors recited in claim 1. Instead, Resasco '800 provides a similar disclosure in this regard as Resasco '016 (see, column 7, lines 32 to 35 in Resasco '800). In common with Resasco '016, the method of Resasco '800 involves exposing the catalytic particles to a reducing gas (hydrogen being the reducing gas) (see, column 3, line 65 to column 4, line 12 in Resasco '800). Thus, even if one were to combine Resasco '800 with Resasco '016 Weidenkaff and Kawakami, one of ordinary skill in the art would not achieve the method of production of carbon nanotubes claimed in claim 1. Consequently none of Resasco '016, Weidenkaff, Kawakami and Resasco '800, alone or in combination, disclose, teach or suggest the subject matter recited in claim 20 which depends from claim 1.

Therefore, Applicant respectfully submits that claim 20 is patentable over the purported combination of Resasco '016, Weidenkaff, Kawakami and Resasco '800. Thus, it is respectfully requested that the rejection of claim 20 under 35 U.S.C. § 103(a) over the purported combination of Resasco '016, Weidenkaff, Kawakami and Tennent '800 be withdrawn.

Claim 23 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Weidenkaff, Kawakami in light of U.S. Patent No. 6,290,775 to Kohlen et al. (hereinafter "Kohlen"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 23 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 23 is patentable over the combination of Resasco '016, Weidenkaff, Kawakami.

Kohlen fails to overcome the deficiencies noted above in the combination of Resasco '016, Weidenkaff, Kawakami. Kohlen was relied upon as allegedly disclosing fluidized bed reactors that can be arranged vertically or at an angle. Kohlen does not disclose, teach or suggest the subject matter recited in claim 1. Consequently none of Resasco '016, Weidenkaff, Kawakami and Kohlen, alone or in combination, disclose, teach or suggest the subject matter recited in claim 23 which depends from claim 1.

Therefore, Applicant respectfully submits that claim 23 is patentable over the purported combination of Resasco '016, Weidenkaff, Kawakami and Kohlen. Thus, it is respectfully requested that the rejection of claim 23 under 35 U.S.C. § 103(a) over the purported combination Resasco '016, Weidenkaff, Kawakami and Kohlen be withdrawn.

Claim 25 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco '016, Weidenkaff, Kawakami in light of U.S. Patent No. 5,973,444 to Xu et al. (hereinafter "Xu"). Applicant respectfully traverses this rejection for at least the following reasons.

Claim 25 depends from claim 1. Therefore, for at least the reasons provided above with respect the claim 1, Applicant respectfully submits that claim 25 is patentable over the combination of Resasco '016, Weidenkaff, Kawakami.

Xu fails to overcome the deficiencies noted above in the combination of Resasco '016, Weidenkaff, Kawakami. Xu was relied upon as allegedly disclosing nickel formate can be used in place of nickel oxalate as the catalyst precursor. Xu does not disclose, teach or suggest the subject matter recited in claim 1. Consequently none of Resasco '016, Weidenkaff, Kawakami and Xu, alone or in combination, disclose, teach or suggest the subject matter recited in claim 25 which depends from claim 1.

Therefore, Applicant respectfully submits that claim 25 is patentable over the purported combination of Resasco '016, Weidenkaff, Kawakami and Xu. Thus, it is respectfully requested that the rejection of claim 25 under 35 U.S.C. § 103(a) over the purported combination Resasco '016, Weidenkaff, Kawakami and Xu be withdrawn.

CONCLUSION

Having addressed each of the foregoing rejections, it is respectfully submitted that a full and complete response has been made to the outstanding Office Action and, as such, the application is in condition for allowance. Notice to that effect is respectfully requested.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Date: January 28, 2011

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